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Cupania americana L. Guara

Sapindaceae Soapberry family

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John K. Francis

Cupania americana L., commonly known as guara (Spanish), candlewood or maraquil (English), and bois de satanier (French), is a medium-sized tree of the moist forests of the Caribbean region. The tree is recognized by its smooth, gray trunk (fig. 1) and large, dark green leaves. It is widespread and common but rarely forms more than a small percentage of a stand. The wood is used principally for firewood and fenceposts.

HABITAT

Native Range

Guara is native to Cuba, Jamaica, Hispañola, Puerto Rico, Martinique, Barbados, Trinidad and Tobago, Venezuela, and Colombia (*11, 20,* fig. 2). Thus, the range extends from 4° to 23° N. latitude. No plantations outside the native range are documented.

Climate

Guara requires a moist climate. In Puerto Rico, the species grows in areas receiving from 1400 to 2600 mm annual precipitation. It grows in somewhat drier areas as a riparian species. Rainless periods of 2 to 4 months occur annually in some parts of the range. Mean monthly temperatures vary from 22 °C in January and 27 °C in July in the Greater Antilles. In continental South America, mean temperatures are more or less constant throughout the year but vary from 20 to 28 °C by area (*8, 19*). Frosts do not occur within the native range of guara.

Soils and Topography

Guara is most frequently found on clay soils (*14*) but is reportedly indifferent to soil properties (*4*). In Trinidad and Tobago, the species reportedly requires well-drained soil (*14*), while in Jamaica it is mainly found in poorly drained areas (*1*). It is certain that the species requires moist soils and does not tolerate excessively drained soils. In Puerto Rico, guara principally colonizes the soil orders Ultisols, Oxisols, and Inceptisols. Forest habitats are moist coastal plains, foothills, and stream bottoms (*11*). Particularly favorable sites are valleys between moist limestone hills. Elevations may range from near sea level to about 300 m (*1, 9*).

Associated Forest Cover

In the Sierra Maestra Mountains of Cuba, guara was a minor component in stands dominated by *Andira inermis* (W. Wright) H.B.K., *Calophyllum brasiliense* Camb., *Cecropia peltata* L., *Hibiscus* sp., *Oxandra lanceolata* (Sw.) Baill., *Persea* sp., and *Prunus occidentalis* Sw. (*18*). In western Cuba, guara grows in mixed stands with *Roystonea regia* (H.B.K.) O.F. Cook, *Cupania glabra* Sw., and *C. macrophylla* A. Rich. (*12*). Guara was noted as a component of a young secondary stand in Puerto Rico dominated by *Hymenaea courbaril* L. and *Bucida buceras* L. (*7*). A mesic forest with limestone parent material in central Puerto Rico had a minor component

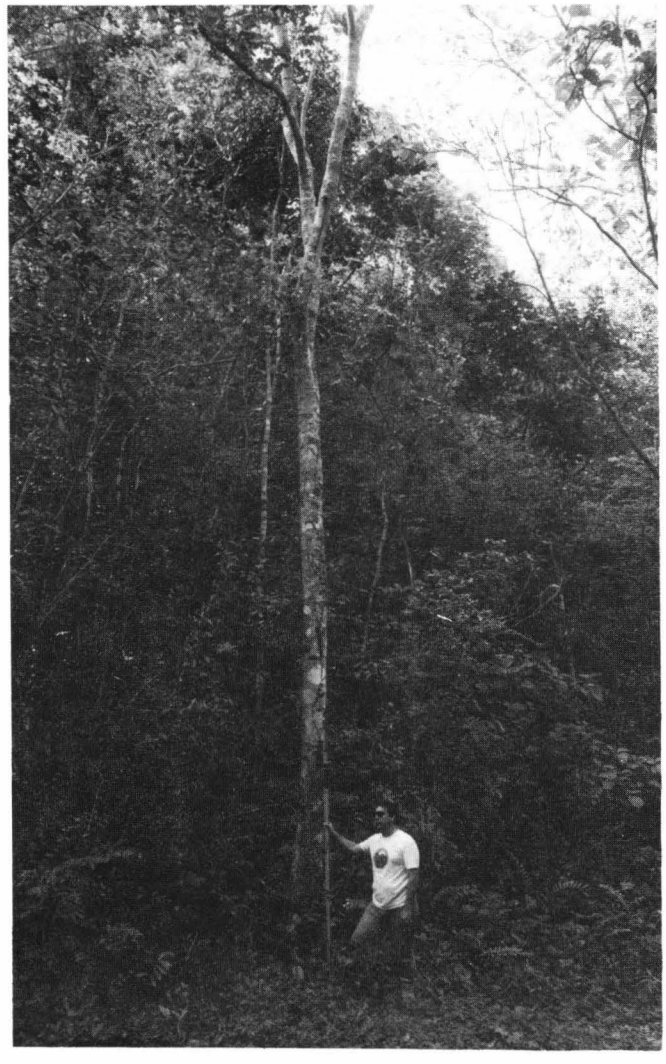

Figure 1.—*Guara tree* (Cupania americana) *growing in a secondary forest in Puerto Rico.*

John K. Francis is a research forester at the Institute of Tropical Forestry, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Río Piedras, PR 00928, in cooperation with the University of Puerto Rico, Río Piedras, PR.

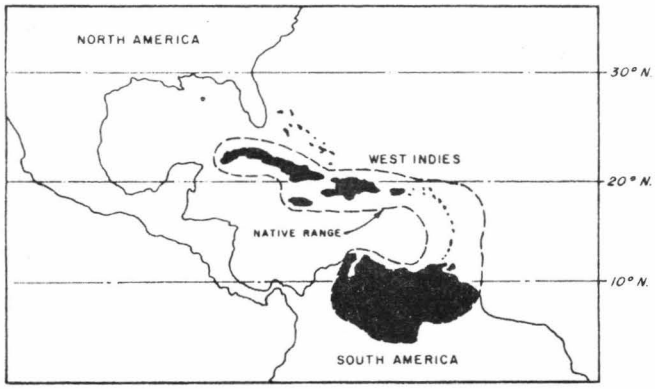

Figure 2.—*The native range of guara* (Cupania americana) *in the neotropics.*

of guara and was dominated by *Zanthoxylum martinicense* (Lam.) DC., *Phoebe elongata* (Vahl) Nees, *Spondias mombin* L., *Dendropanax arboreus* (L.) Decne. & Planch., and *Inga laurina* (Sw.) Willd. (*5*). Relic forest stands in Barbados contain guara with dominants *Hymenaea courbaril* L., *Hernandia sonora* L., *Sapium glandulosum* (L.) Morong, *Roystonea oleracea* (Jacq.) Cook, *Hura crepitans* L., *Ceiba pentandra* (L.) Gaertn., and *Citharexylum spinosum* L. (*3*).

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—Composed of small, white, flowers, panicles, 30 to 40 cm long, are produced in the winter or spring (*11*). The flowers in each panicle are generally unisexual (*9*); the trees appear to be monoecious. The fruits are three-seeded capsules and mature 5 or 6 months after flowering. When mature, the capsules split open, exposing 8- to 9-mm diameter seeds, which may remain attached for several days. The seeds are shiny black and have an orange, fleshy aril attached to one end (*14*).

Seed Production and Dissemination.—Seed production begins in open-grown trees when they reach 4 or 5 meters in height. One to several hundred seeds may be produced by a large tree in one seed crop. Two seed lots collected in Puerto Rico averaged 0.284 and 0.363 g per seed (*13*; author, personal observation). Fresh seeds from Puerto Rico contained an average moisture content of 46.6 percent.[1] Dispersal is attributed to birds that eat the fleshy aril attached to the seeds (*14*). In Puerto Rico, the seeds are regularly moved into openings and disturbed areas.

Seedling Development.—Germination is hypogenous and occurs 4 to 10 weeks after sowing (*14*). The seeds germinate easily on moist peat or potting mix. No scarification is necessary. Twenty-four and 56 percent germination rates were obtained in tests of two Puerto Rican seedlots (*13;* author, personal observation). Unsealed storage at room temperature for even 1 month resulted in complete loss of seed viability.[2] Some of the seeds have double embryos, and two epicotyls emerge but quickly self-thin. The seedling stems elongate until at the two-leaf stage; seedlings are 10 to 12 cm tall. The first seedling leaves have the appearance of adult leaves, except they are more slender and pointed. Seedlings can be transplanted at this point to nursery bags. Growth is somewhat slow; seedlings in shaded nursery beds averaged 16 cm tall at the end of 6 months.[3] Ten months were required for a small group of seedlings to reach a plantable height of 45 cm under partial shade (author, personal observation).

Seedlings can be grown and transplanted as containerized stock. Seedlings 8 cm tall in paper pots planted during a moist year had nearly 100-percent first-year survival.[4] Because they are not very drought-hardy, seedlings probably would not easily transplant as bare-root stock. Direct-seeding during the rainy season has been suggested as a means of propagation.[5] Broadcasting seeds generally results in failure; it is recommended that they be dibbled into prepared seedspots (*14*).

Early growth varies considerably. In a moist forest in Puerto Rico, with shallow clay soil over porous limestone, measured heights of planted seedlings averaged 0.6 m at 3 years, 0.8 m at 4 years, 1.8 m at 5 years, and 2.4 m at 7 years.[6] In Trinidad and Tobago, 2- and 3-year-old seedlings averaged 2.1 and 3.0 m tall (*14*).

Vegetative Reproduction.—The species is reported to coppice freely (*14*). Severed roots often sprout, but hardwood cuttings from saplings did not root when placed in moist soil under shade (author, personal observation).

Sapling and Pole Stage to Maturity

Growth and Yield.—The growth rate of guara is poorly documented. After relatively rapid early growth, the rate seems to decline. In a moist forest in Puerto Rico, two trees, probably in intermediate crown positions, averaged 0.23 cm diameter growth per year over a 26-year period (*21*). Codominant guara trees in secondary forest stands in Puerto Rico that began 40 to 60 years ago now are 20 to 35 cm in diameter at breast height (d.b.h.) and 16 to 22 m tall.

It is unlikely that guara will be planted commercially in the future, and natural regeneration practices will undoubt-

[1] Wadsworth, Frank H. 1945. Final report on seed studies with guara. Management File No. 660. Institute of Tropical Forestry, Río Piedras, Puerto Rico.

[2] Marrero, José. 1944. Final report on the storage of *Cupania americana*. Management File No. 661. Institute of Tropical Forestry, Río Piedras, PR.

[3] Wadsworth, Frank H. 1944. Final report on seedling growth of guara. Management File No. 416. Institute of Tropical Forestry, Río Piedras, PR.

[4] Wadsworth, Frank H. 1947. Final report on planting of guara at Cambalache. Management File No. 1047. Institute of Tropical Forestry, Río Piedras, PR.

[5] Jenkins, Michael B. 1988. The useful trees of Haiti: a selected review. New Haven, CN. 238 p. Draft manuscript on file at the Institute of Tropical Forestry, Río Piedras, PR.

[6] Marrero, José. 1957. Final Report. 1.3-5. *Cupania americana*. Management File No. 1747. Institute of Tropical Forestry, Río Piedras, PR.

edly target faster growing and more valuable species. However, guara does produce a useful wood, and where it occurs in stands, well-formed trees should be retained, if possible, without sacrificing more valuable trees. In stands managed for multiple use, guara contributes food for wildlife, adds to ecological diversity, and is a very attractive component of the forest landscape.

Rooting Habit.—Seedlings develop a woody taproot with many fibrous laterals (*14*). Large trees in clay soil have a well-developed lateral root system with sinkers; taproots are not prominent in clay soils. The lateral roots are moderately thick, shallow, and extensive. Some trees have small buttresses. The fine roots terminate in rhizomorphs.

Reaction to Competition.—Guara is intolerant of shade (*14*). Seedlings and saplings can survive for several years in understories where there is good filtered light. However, full or nearly full sunlight is needed for seedlings to develop into trees. The species is usually confined to secondary forests where it establishes itself following disturbance. Guara trees in young stands may be dominants. As the stand develops, they are relegated to codominant and eventually intermediate crown positions by taller secondary trees. Even guara trees in intermediate crown positions are able to produce seeds. However, natural regeneration is not plentiful (*14*), and trees tend to be scattered. Occasionally, small groups of guara occur, but pure stands probably do not exist.

Guara trees accounted for about 1 to 4 percent of the total basal area in four secondary forest stands sampled in Puerto Rico, ranging in basal area from 14 to 29 m^2/ha (*5, 7, 21*). In a forest of *Carapa guianensis* Aubl.-*Pentaclethra macroloba* (Wild.) Kuntze-*Sabal* spp. type in Trinidad and Tobago, just four guara trees (codominant-intermediate crown classes) were found on 40 ha (*2*). Twenty-five codominant trees in mixed secondary stands in Puerto Rico had an average crown ratio (crown diameter/d.b.h.) of 33.8 ± 1.2 (author, personal observation). This moderately high figure indicates a diffuse, spreading crown.

Damaging Agents.—Three homopterans have been noted feeding on guara in Puerto Rico (*15*); twig mortality is sometimes the result of their attack. Lepidopteran caterpillars frequently feed on guara foliage but seldom do serious damage. The larvae of an unidentified insect destroyed a high percentage of the seeds of many trees in one area in Puerto Rico (author, personal observation). The wet-wood termite *Nasutitermes costalis* (Holmgren) occasionally makes trails up the trunks of guara trees to feed on dead limbs and twigs. The wood of guara is listed as very susceptible to attack by the drywood termite *Cryptotermes brevis* (Walker) (*22*).

Guara appears resistant to trunk snap and breakage of limbs in high winds and is moderately resistant to wind throw. It refoliates quickly after hurricanes strip the foliage.

SPECIAL USES

The heartwood of guara is pinkish tan, resulting from the mixture of a reddish brown, fine grain pattern on a tan background. The sapwood is ivory colored. The heartwood is hard and moderately heavy, with specific gravities of 0.55 g/cm^3 (oven-dry, from Puerto Rico; author, personal observation) and 0.79 g/cm^3 (moisture content unknown, from Trinidad and Tobago; *14*). The sapwood specific gravity (moisture content not given) is reported as 0.4 g/cm^3 (*9, 11*). Interlocking grain is evident. The wood is sawed and planed fairly easily with some wooliness on the crossgrain. It reportedly takes a high polish (*6*). In the Dominican Republic, Puerto Rico, and Trinidad and Tobago, the wood is used principally for posts, poles, rough construction, firewood, and charcoal (*9, 11, 14, 17*). Guara wood is attractive and appears to be very strong. Although the average size of guara logs is small, the wood could be used to manufacture furniture, craft items, trim, pallets, and crates.

Guara supplies nectar to honey bees. It has been suggested as an ornamental and shade tree although it is still virtually unknown to the public. The leaves are used in folk medicine to control pain and the seeds to treat dysentery (*9, 16*).

GENETICS

There are about 45 species of *Cupania*. They are confined to the New World from Mexico and the Caribbean Islands to Argentina (*10*).

Guara is closely related to *C. triquetra* A. Rich., which ranges from Hispañola to Martinique (*11*); the species is easily distinguished by its angular seed capsules but otherwise appears almost identical. In Puerto Rico, *C. triquetra* tends to be slightly larger, to be of better form, and to prefer more fertile sites; it is less common than guara.

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